EXHIBIT B

Medtronic	*Neurological*	**Document Number** 288117-70205	Rev/Version 1.0	Sht 1 of 49
Title: Neuro Patient Programmer Platform Electrical DVT Report				

Revision History:

Revision	Comments
1.0	Initial release for routing

1 INTRODUCTION

This document is the electrical Design Verification Test (DVT) Report for the 37741 Patient Programmer Platform.

1.1 Purpose

The purpose of this report is to document the results of test plan .

1.2 Scope

This report applies only to design verification testing of the 37741 Patient Programmer Platform.

1.3 Document Overview

This document is organized as follows:

- Section 2 contains references and definitions.
- Section 3 contains a table with the list of tests, software revisions, sample sizes, and test results.
- Section 4 contains the results of the electrical design verification tests.

2 REFERENCES AND DEFINITIONS

This section identifies internal and external reference documents that augment the information provided in this document. It also defines terms, acronyms, and abbreviations used within the document.

2.1 Internal Medtronic References

Number	Name
120275	
215387	
288117-70040	
288117-70044	
288117-70029	
503011001	
288117-70200	

Note: Document revisions referenced in DVT Plan.

2.2 External References

Reference the PEM Electrical Specification for external specification standards.

2.3 Definitions, Acronyms, and Abbreviations

ARB: Arbitrary Waveform Generator

ARB equipment: One or more arbitrary waveform generators, used alone or in conjunction to generate sophisticated waveforms.

DUT: Device Under Test

DVT: Design Verification Test

DVT Console: The test console needed to perform the tests specified herein.

ES: Electrical Specification #120275

GPIB: General Purpose Interface Bus

PEM: Patient Electronic Module

PP: Patient Programmer

POR: Power On Reset

3 Test Results Summary

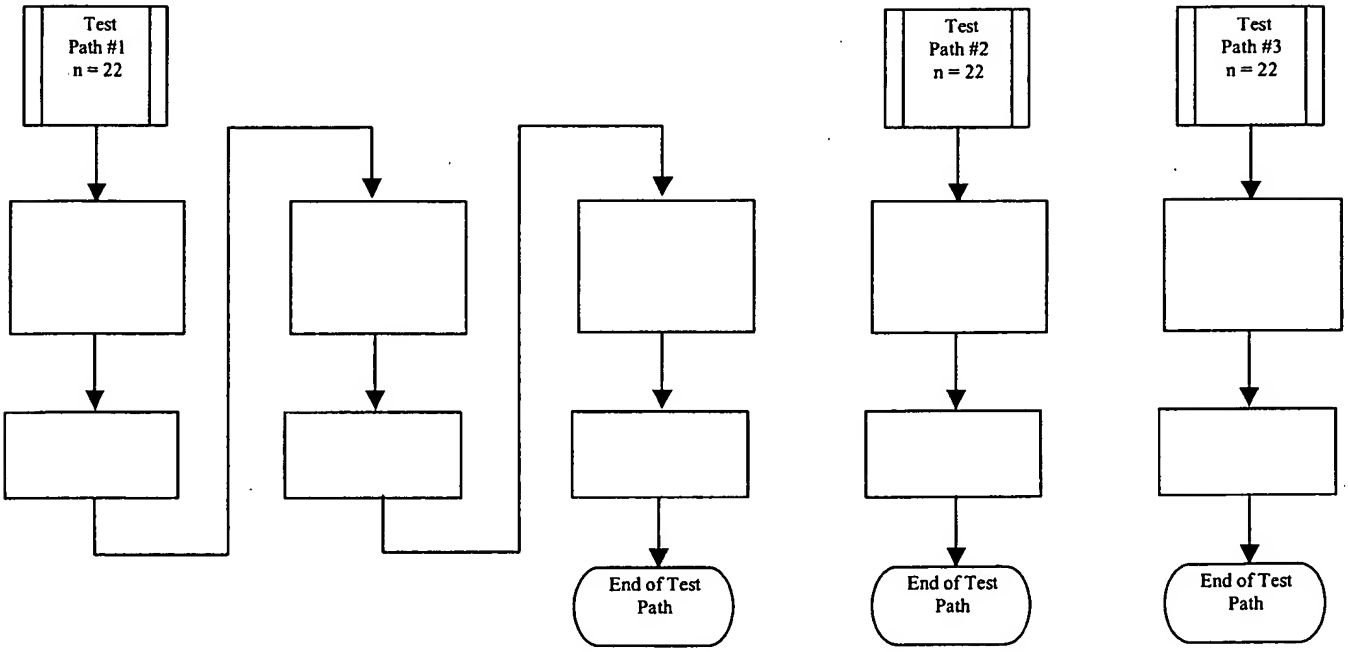
Table 1 summarizes the results of all electrical design verification testing. Section 4 details each test setup, criteria, and results.

- Test data is stored as 288117-70200.
- Table 1 indicates test name, sample size, DUT software revision, Test Script Software revision, test path, and results.
- Test paths are shown in section 3.1.

Table 1

Test Name	Sample Size	DUT Software Revision	Script Software Test Revision	Test Path	Results
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	22				PASS
	1				PASS

3.1 Test Paths



4 ELECTRICAL TESTS

This section specifies electrical tests performed on the 37741 Patient Programmer Platform.

4.1 Power Source Tests

4.1.1 Current Drain Test

4.1.1.1 Objective

To verify the current drain meets the requirements specified in the *Power Source* section of the PEM Electrical Specification.

4.1.1.2 Method and Equipment

4.1.1.3 Test Cases

There are _ test cases for transmit using all combinations of test values below:

Parameter	Test Values	Units

The

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

There are test cases using two combinations of test values below:

Parameter	Test Values	Units

There are total test cases.

4.1.1.4 Acceptance Criteria

Operating Condition (Ref.)	Antenna	Duty Cycle (%)	Current Drain (mA) MAX		
			V	V	V
Row A	INT				
Row B	INT				
Row C	INT				
Row D	INT				
Row E	INT				
Row F	INT				
Row G	INT				
Row H	EXT				
Row I	INT				
Row J	INT				

Note 1:

4.1.1.5 *Test Setup*

1.
2.
3.

4.

4.1.1.6 *Test Procedure*

1.
2.

3.

4.

4.1.1.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Operating Condition	Current Drain (mA) MAX															
Row	Spec	Min	Max	Mean	Std Dev		Spec	Min	Max	Mean	Std Dev		Spec	Min	Max	Mean	Std Dev	
A																		
B																		
C																		
D																		
E																		
F																		
G																		
H																		
I																		
J																		

4.1.2 Supply Voltage Range Test

4.1.2.1 Objective

To verify the supply voltage range meets the requirements specified in the *Power Source* section of the PEM Electrical Specification.

4.1.2.2 Method and Equipment

4.1.2.3 Test Cases

Parameter	Test Values	Units

The

There is test case without transmit:

Parameter	Test Values	Units

4.1.2.4 *Acceptance Criteria*

Operating Condition	Antenna	H-Bridge Drive Duty Cycle (%)	Min operating voltage (V)

4.1.2.5 *Test Setup*

1.
2.
3.

4.

4.1.2.6 *Test Procedure*

1.

2.

3.

4.1.2.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Operating Condition	Antenna	Supply Voltage Range (Volts)				
		Min	Max	Avg	Std Dev	

4.2 Input/Output Connections Tests

4.2.1 Keypad Interface Test

4.2.1.1 *Objective*

To verify the keypad interface meets the requirements specified in the *Input/Output Connections* section of the PEM Electrical Specification.

4.2.1.2 *Method and Equipment*

4.2.1.3 *Test Cases*

Parameter	Test Values	Units

4.2.1.4 *Acceptance Criteria*

4.2.1.5 *Test Setup*

1.
2.

3.

4.2.1.6 *Test Procedure*

3.

4.2.1.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Tests	**Keypad Interface (pass/fail)**		
	Pass	Pass	Pass
	Pass	Pass	Pass

4.2.2 Display Interface Test

4.2.2.1 *Objective*

To verify the display interface meets the requirements specified in the *Input/Output Connections* section of the PEM Electrical Specification.

4.2.2.2 *Method and Equipment*

4.2.2.3 *Test Cases*

There are test cases using combinations of the test values below:

Parameter	**Test Values**	**Units**

4.2.2.4 *Acceptance Criteria*

Test Parameters				Requirements			

4.2.2.5 *Test Setup*

1.
2.

3.

4.2.2.6 *Test Procedure*

1.

2.
3.

4.

4.2.2.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Test	Display Interface (pass/fail)		
	Pass	Pass	Pass
	Pass	Pass	Pass
	Pass	Pass	Pass

4.2.3 External Antenna Interface Test

4.2.3.1 *Objective*

To verify the external antenna interface meets the requirements specified in the *Input/Output Connections* section of the PEM Electrical Specification.

4.2.3.2 *Method and Equipment*

4.2.3.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.2.3.4 *Acceptance Criteria*

- When an external antenna is connected, there should be no downlink from the internal antenna.
- When an external antenna is connected, the uP should detect that the antenna is connected.

External Antenna					
	Min	Max	Min	Max	Yes/No

4.2.3.5 *Test Setup*

1.
2.
3.
4.

5.

4.2.3.6 *Test Procedure*

1.

2.

3.

4.

4.2.3.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Test Configuration	Test
	A
	B

Test	External Antenna Interface (A/m)											
	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev
A												
B												

4.2.4 Infrared Port Interface Test

4.2.4.1 Objective

To verify the infrared port interface meets the requirements specified in the *Input/Output Connections* section of the PEM Electrical Specification. [PTPROG_PEMT-0006:*]

4.2.4.2 Method and Equipment

4.2.4.3 Test Cases

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.2.4.4 Acceptance Criteria

All	All	None

4.2.4.5 Test Setup

1.
2.

3.

4.2.4.6 *Test Procedure*

1.
2.
3.
4.

4.2.4.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Voltage (V)	Infrared (pass/fail)								
	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

4.2.5 Audio Transducer Test

4.2.5.1 *Objective*

To verify the audio transducer meets the requirements specified in the *Input/Output Connections* section of the PEM Electrical Specification.

4.2.5.2 *Method and Equipment*

4.2.5.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.2.5.4 *Acceptance Criteria*

4.2.5.5 *Test Setup*

1.
2.
3.
4.

5.

4.2.5.6 *Test Procedure*

1.
2.
3.
4.

4.2.5.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

	Audio Transducer (dB SPL)											
	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev

4.2.6 Manufacturing/Test Interface Test

Manufacturing requirements defined in Test Specification, Patient Programmer, 215387.

4.3 Internal Resources Tests

4.3.1 Memory Test

4.3.1.1 *Objective*

To verify the internal memory resources meet the requirements specified in the *Internal Resources* section of the PEM Electrical Specification.

4.3.1.2 *Method and Equipment*

4.3.1.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.3.1.4 *Acceptance Criteria*

All	Pass

4.3.1.5 *Test Setup*

1.
2.
3.

4.3.1.6 *Test Procedure*

1.
2.
3.
4.

4.3.1.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Test	Memory (pass/fail)		
	Pass	Pass	Pass
	Pass	Pass	Pass
	Pass	Pass	Pass

4.3.2 Real-Time Clock Backup Test

4.3.2.1 *Objective*

To verify the real-time clock backup meets the requirements specified in the *Internal Resources* section of the PEM Electrical Specification.

4.3.2.2 *Method and Equipment*

4.3.2.3 *Test Cases*

There is one test case below:

Parameter	Test Value	Units

4.3.2.4 *Acceptance Criteria*

Test Case	Min Time w/o power (min)

4.3.2.5 *Test Setup*

1.
2.

3.

4.3.2.6 *Test Procedure*

1.
2.
3.
4.
5.

4.3.2.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Test	**Real-Time Backup (pass/fail)**		
	Pass	Pass	Pass

4.3.3 Real-Time Clock Accuracy Test

4.3.3.1 *Objective*

To verify the real-time clock accuracy meets the requirements specified in the *Internal Resources* section of the PEM Electrical Specification.

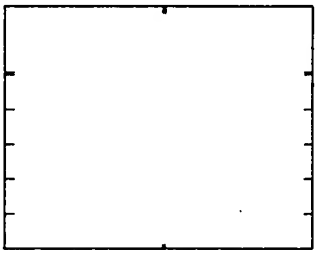
4.3.3.2 *Method and Equipment*

4.3.3.3 *Test Cases*

There are test cases (actually measurement points) using all combinations of test values below:

Parameter	**Test Value**	**Units**

4.3.3.4 *Acceptance Criteria*



4.3.3.5 *Test Setup*

1.
2.

4.3.3.6 *Test Procedure*

1.

2.

4.3.3.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

	Real Time Clock Accuracy (seconds)				

4.3.4 A/D Measurements Test

4.3.4.1 *Objective*

To verify the A/D measurement accuracy meets the requirements specified in the *Internal Resources* section of the PEM Electrical Specification.

4.3.4.2 *Method and Equipment*

4.3.4.3 *Test Cases*

There are test cases using the test values below:

Parameter	Test Values	Units

4.3.4.4 *Acceptance Criteria*

A/D Voltage	Test Value	Max Error (%)

4.3.4.5 *Test Setup*

1.
2.
3.

4.

5.

4.3.4.6 *Test Procedure*

1.

2.

3.

4.

4.3.4.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Input	Level	A/D Measurement (% ERROR)											
		Ambient Temp				Low Temp				High Temp			
		Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev

4.3.5 D/A Control Voltages Test

4.3.5.1 *Objective*

To verify the D/A accuracy meets the requirements specified in the *Internal Resources* section of the PEM Electrical Specification.

4.3.5.2 *Method and Equipment*

4.3.5.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Value	Units

4.3.5.4 *Acceptance Criteria*

D/A Voltage	Measurement point	Max % Error

4.3.5.5 *Test Setup*

1.
2.
3.

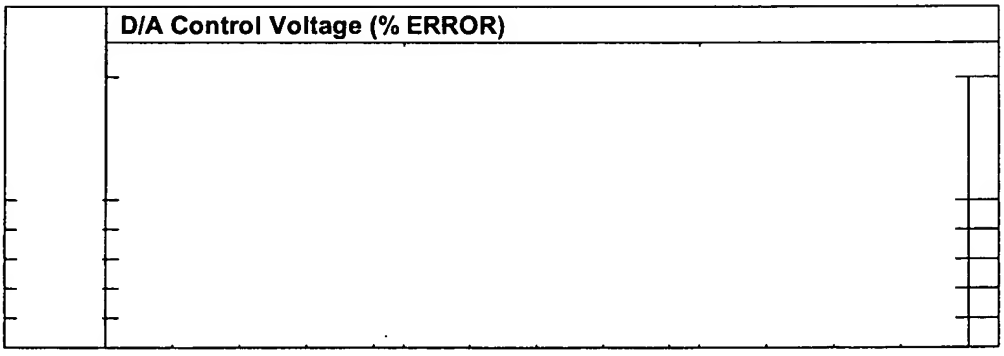
4.

4.3.5.6 *Test Procedure*

1.
2.
3.

4.3.5.7 *RESULTS* **PASS**

All devices met the acceptance criteria.



4.4 Transmit Telemetry (Downlink) Tests

4.4.1 Magnetic Field Intensity Test

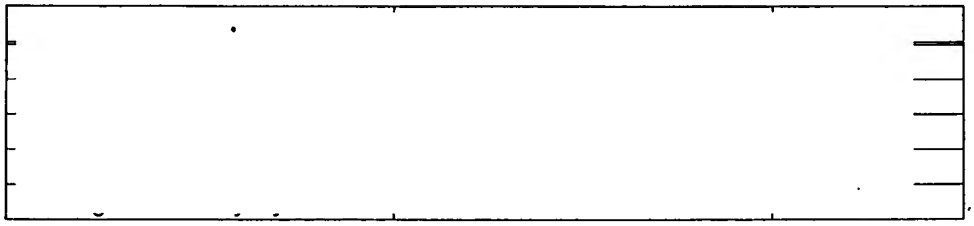
4.4.1.1 *Objective*

To verify downlink magnetic field intensity meets the requirements specified in the *Transmit Telemetry (Downlink)* section of the PEM Electrical Specification.

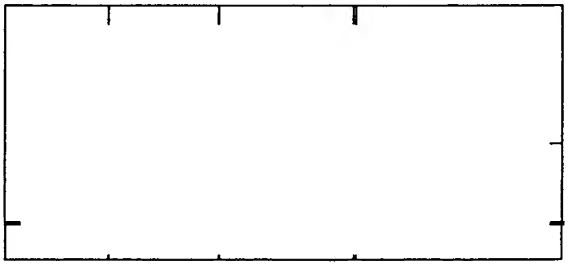
4.4.1.2 *Method and Equipment*

4.4.1.3 *Test Cases*

There are test cases at kHz using all combinations of test values below:



4.4.1.4 *Acceptance Criteria*



4.4.1.5 *Test Setup*

1.
2.
3.
4.

5.

4.4.1.6 *Test Procedure*

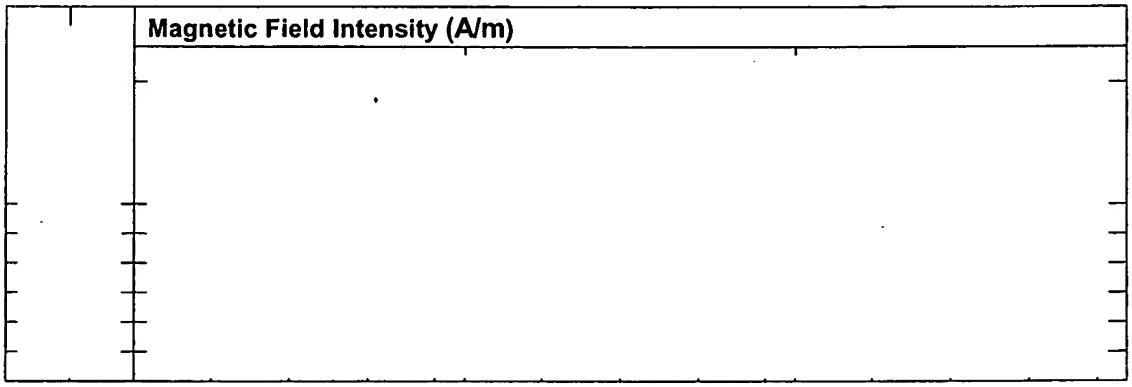
1.
2.

3.
4.

5.

4.4.1.7 *RESULTS* **PASS**

All devices met the acceptance criteria.



4.4.2 Burst Characteristics Test

4.4.2.1 *Objective*

To verify downlink burst characteristics of width, rise time, fall time, frequency, and overshoot meet the requirements specified in the *Transmit Telemetry (Downlink)* section of the PEM Electrical Specification.

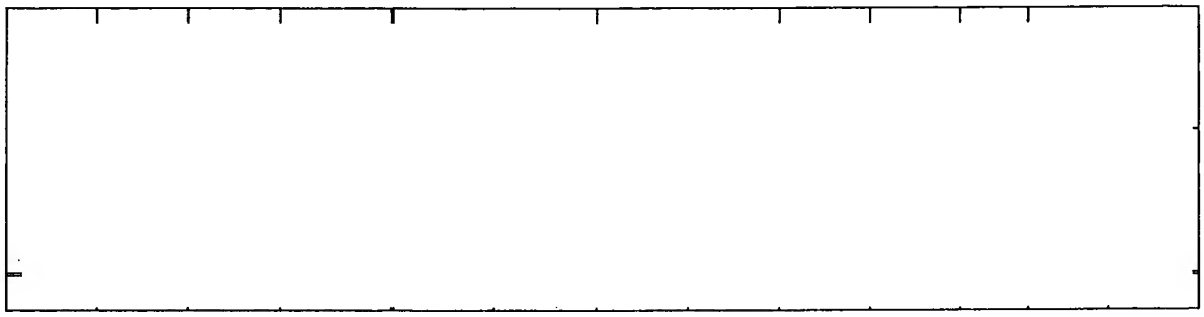
4.4.2.2 *Method and Equipment*

4.4.2.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.4.2.4 *Acceptance Criteria*



4.4.2.5 *Test Setup*

1.
2.
3.
4.

5.

4.4.2.6 *Test Procedure*

1.
2.

3.
4.
5.

4.4.2.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

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Antenna	Voltage	Test	Burst Characteristics											
			Ambient Temp				Low Temp				High Temp			
			Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev

4.5 Receive Telemetry (Uplink) Tests

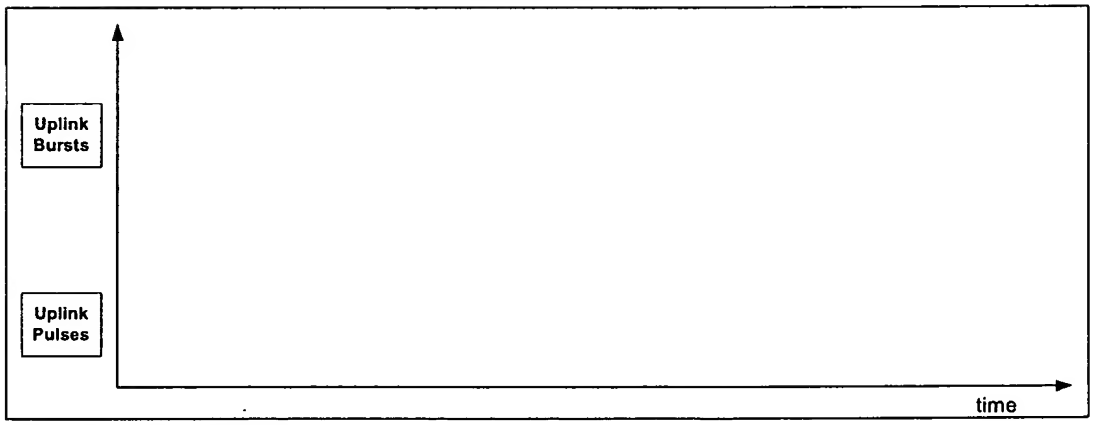
4.5.1 Detection Threshold Test

4.5.1.1 *Objective*

To verify uplink detection threshold (i.e. receiver sensitivity) meets the requirements specified in the *Receive Telemetry (Uplink)* section of the PEM Electrical Specification.

4.5.1.2 *Method and Equipment*

Figure 1: Example Uplink Detection Threshold Test Waveforms



4.5.1.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

The supply voltage is 2.5 V.

4.5.1.4 *Acceptance Criteria*

Antenna	Telemetry Type	Detection Onset (Uplink dB)	Detection Threshold (Uplink dB)	Maximum Input Level (Uplink dB)
		Max	Max	Max

4.5.1.5 *Test Setup*

1.
2.
3.
4.

5.

4.5.1.6 *Test Procedure*

1.
2.
3.

4.

4.5.1.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Antenna	Telemetry	Detection Threshold (dB)													
		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev

Antenna	Telemetry	Maximum Input Level (pass/fail)		
		Pass	Pass	Pass
		Pass	Pass	Pass
		Pass	Pass	Pass
		Pass	Pass	Pass
		Pass	Pass	Pass
		Pass	Pass	Pass

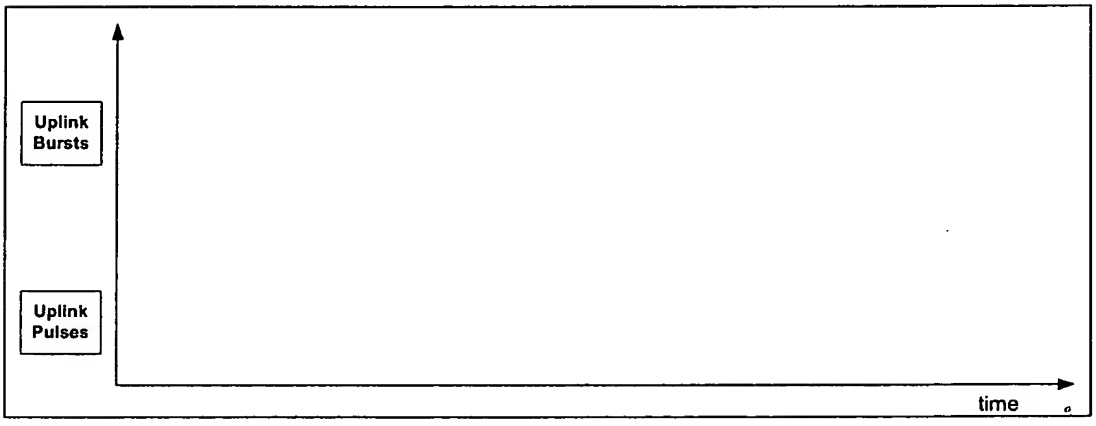
4.5.2 Detection Margin Test

4.5.2.1 *Objective*

To verify uplink detection margin meets the requirements specified in the *Receive Telemetry (Uplink)* section of the PEM Electrical Specification.

4.5.2.2 *Method and Equipment*

Figure 2: Example Uplink Detection Margin Test Waveforms



4.5.2.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.5.2.4 *Acceptance Criteria*

Telemetry Type	Data Bursts	Amplitude A1	Antenna	Detection Margin (Uplink dB)	
				Min	Max

4.5.2.5 *Test Setup*

1.
2.
3.
4.

5.

4.5.2.6 *Test Procedure*

1.
2.
3.

4.

4.5.2.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Antenna	Telemetry	Detection Margin (dB)												
		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev	

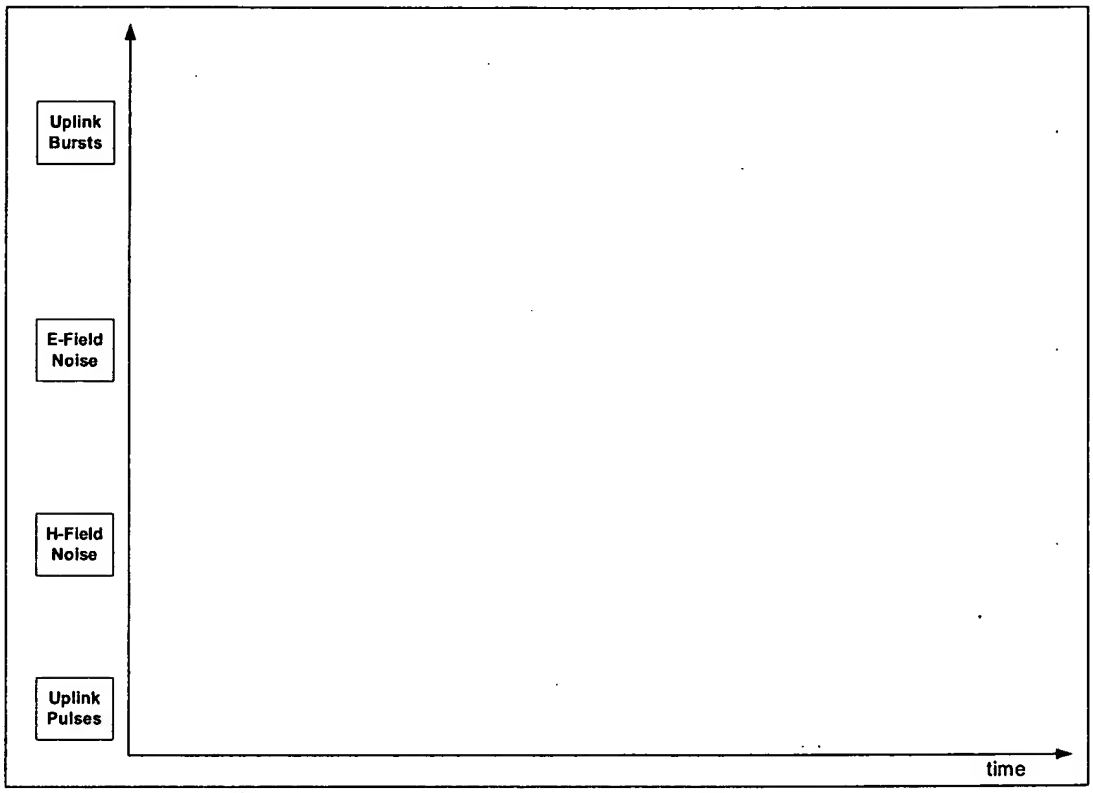
4.5.3 Noise Immunity Test

4.5.3.1 *Objective*

To verify uplink noise immunity meets the requirements specified in the *Receive Telemetry (Uplink)* section of the PEM Electrical Specification.

4.5.3.2 *Method and Equipment*

Figure 3: Example Uplink Noise Immunity Test Waveforms



4.5.3.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.5.3.4 *Acceptance Criteria*

Telemetry Type	Uplink Level A1 (dB)	Antenna	Min E-Noise Immunity (dB)	Min H-Noise Immunity (dB)

4.5.3.5 *Test Setup*

1.
2.
3.
4.
5.

6.

4.5.3.6 *Test Procedure*

1.
2.
3.
4.

5.

4.5.3.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Antenna	Noise	Telemetry	Noise Immunity (dB)													
			Min	Max	Mean	Std dev		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev

4.5.4 Signal Distortion Test

4.5.4.1 *Objective*

To verify uplink signal distortion meets the requirements specified in the *Receive Telemetry (Uplink)* section of the PEM Electrical Specification.

4.5.4.2 *Method and Equipment*

4.5.4.3 *Test Cases*

Parameter	Test Values	Units

There are test cases for Tel A, and test cases for Tel N.

4.5.4.4 *Acceptance Criteria*

Telemetry Type	Uplink Level A1 (dB)	Antenna	Interval Distortion (µS)	Active/Idle Distortion (µS)

4.5.4.5 *Test Setup*

1.
2.
3.
4.

5.

4.5.4.6 *Test Procedure*

1.
2.
3.

4.

4.5.4.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

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Antenna	Test	Uplink (dB)	Signal Distortion Telemetry A (us)												
			Min	Max	Mean	Std dev		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev

Antenna	Test	Uplink (dB)	Signal Distortion Telemetry N, 0's (us)												
			Min	Max	Mean	Std dev		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev

Antenna	Test	Uplink (dB)	Signal Distortion Telemetry N, 1's (us)					Signal Distortion Telemetry N, 0's (us)					Signal Distortion Telemetry Sync (us)				
			Min	Max	Mean	Std dev		Min	Max	Mean	Std dev		Min	Max	Mean	Std dev	

4.5.5 Turnaround Time Test

4.5.5.1 *Objective*

To verify uplink turnaround time meets the requirements specified in the *Receive Telemetry (Uplink)* section of the PEM Electrical Specification.

4.5.5.2 *Method and Equipment*

4.5.5.3 *Test Cases*

There are test cases using all combinations of test values below:

Parameter	Test Values	Units

4.5.5.4 *Acceptance Criteria*

Supply Voltage	H-Bridge Drive Duty Cycle	Turnaround Time (mS)

4.5.5.5 *Test Setup*

1.
2.

3.

4.5.5.6 *Test Procedure*

1.

2.
3.
4.

4.5.5.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Test	Turnaround Time (pass/fail)

4.5.6 Hold Drift Test

4.5.6.1 *Objective*

To verify the hold drift meets the requirements specified in the *Receive Telemetry (Uplink)* section of the PEM Electrical Specification.

4.5.6.2 *Method and Equipment*

4.5.6.3 *Test Cases*

There is test case:

Parameter	Uplink Level	Units

4.5.6.4 *Acceptance Criteria*

Time after hold circuit enabled	Max Hold Drift

4.5.6.5 *Test Setup*

1.
2.
3.

4.5.6.6 *Test Procedure*

1.
2.
3.
4.
5.
6.
7.
8.
9.
10

4.5.6.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

Hold Drift (mV)

4.5.7 New-Battery FET Test

4.5.7.1 *Objective*

To verify that enabling the new-battery FET circuit reduces the receiver noise floor (ambient RF energy detected by the receiver circuit) when new batteries are used.

4.5.7.2 *Method and Equipment*

4.5.7.3 *Test Cases*

There is test case:

Parameter	Uplink Level	Units

4.5.7.4 *Acceptance Criteria*

Supply Voltage	New-Battery FET	RSSI Peak

4.5.7.5 *Test Setup*

1.
2.
3.

4.5.7.6 *Test Procedure*

1.
2.
3.
4.
5.
6.
7.

4.5.7.7 *RESULTS* **PASS**

All devices met the acceptance criteria.

	New-Battery FET (mV)											
	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev

4.6 Telemetry Performance Tests

4.6.1 Telemetry Map Area at a Fixed Distance Test

4.6.1.1 *Objective*

To verify telemetry performance in terms of map area at a fixed distance meets the requirements specified in the *Telemetry Performance* section of the PEM Electrical Specification.

4.6.1.2 *Method and Equipment*

4.6.1.3 *Test Cases*

Parameter	Test Values	Units

There are test cases.

4.6.1.4 *Acceptance Criteria*

IPG	Antenna	Map Area @ 5cm

4.6.1.5 *Test Setup*

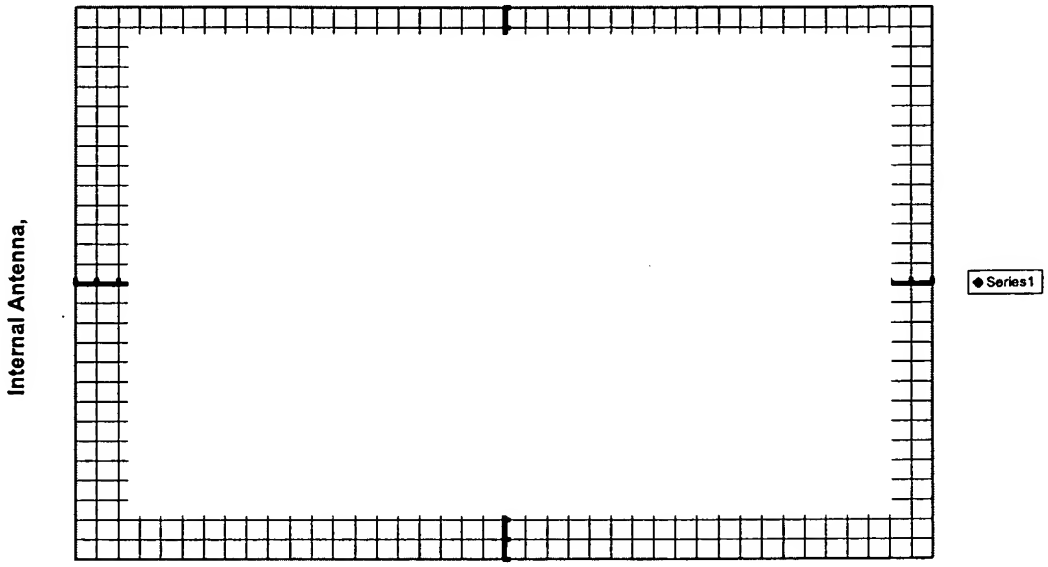
1.
2.

4.6.1.6 *Test Procedure*

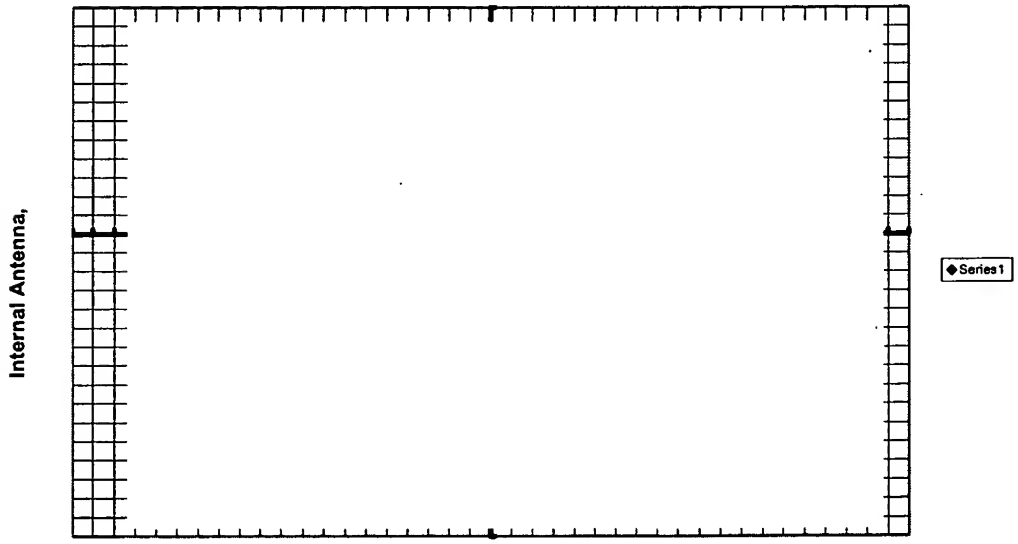
1.
2.
3.
4.
5.
6.
7.
8.

4.6.1.7 *RESULTS* **PASS**

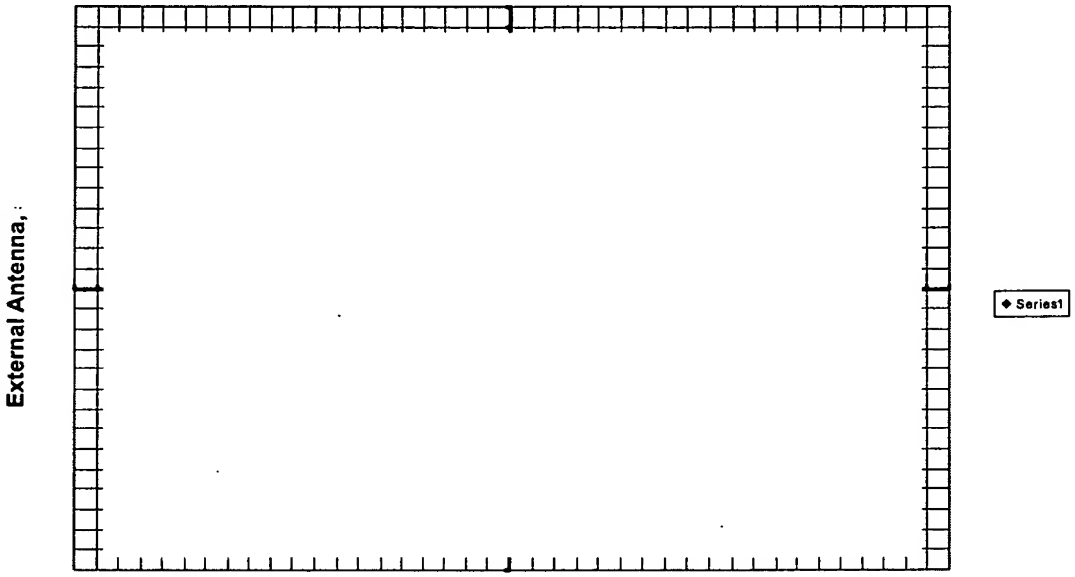
4.6.1.7.1 Internal Antenna Map @



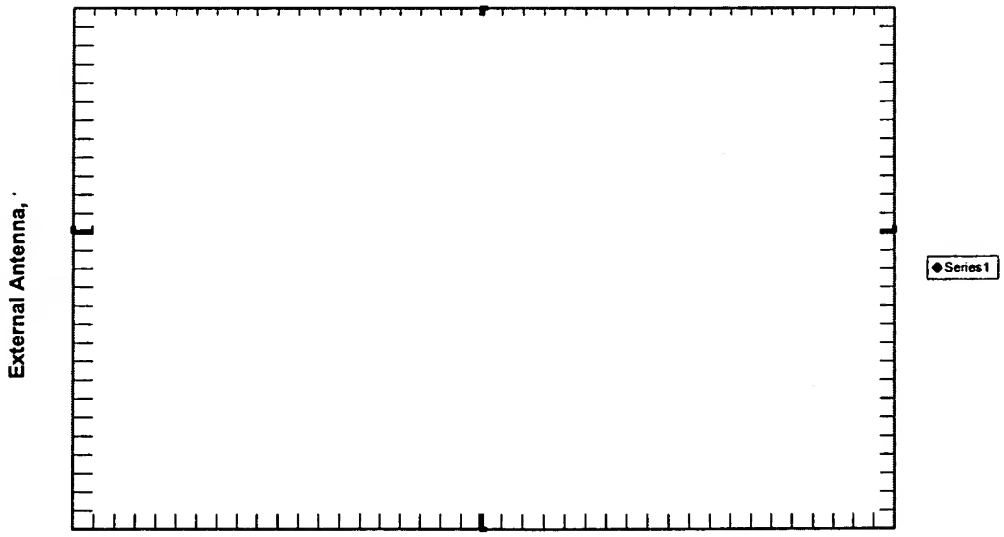
4.6.1.7.2 Internal Antenna @



4.6.1.7.3 External Antenna Map @

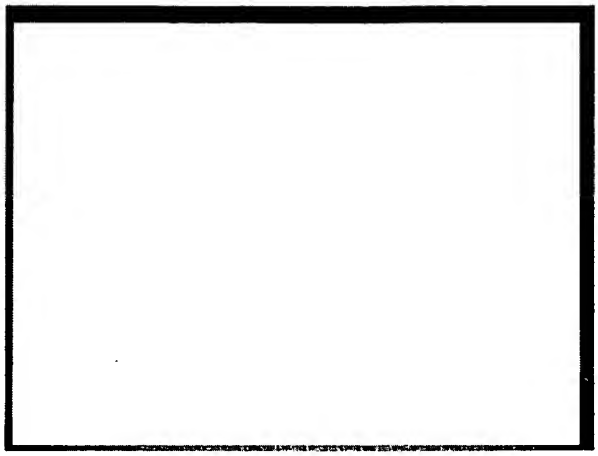


4.6.1.7.4 External Antenna @

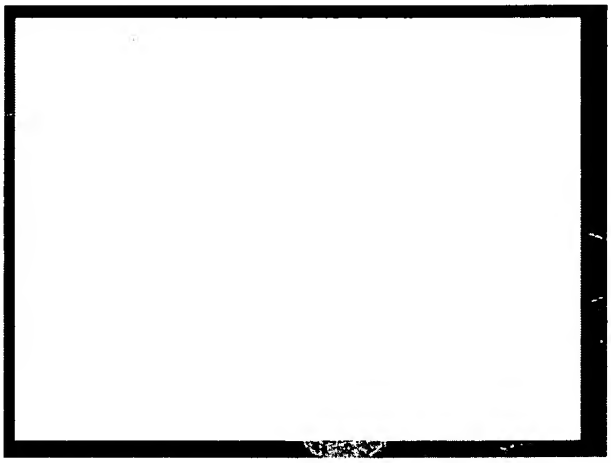


4.6.1.7.5 Photo of test fixture showing

in this photo.



4.6.1.7.6 Photo of



5 COMPLETION

This paragraph concludes this test specification.